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Journal of the American Society of Mining and Reclamation

The Journal of the American Society of Mining and Reclamation **(JASMR)** promotes the exchange of basic and applied solutions for the reclamation, restoration, and revitalization of landscapes impacted by the extraction of natural resources—including, but not limited to coal, minerals, gas, and oil. Contributions reporting original research, case studies, field demonstrations, or policy dealing with some aspect of ecosystem reclamation are accepted from all disciplines for consideration by the editorial board.

Contributions to JASMR

The Journal of the American Society of Mining and Reclamation publishes contributions under the headings Research Papers, Case Studies, Demonstrations, Policy Papers and Review articles. All papers are peer reviewed. Manuscripts may be volunteered, invited, or coordinated as a symposium.

Research Papers: Emphasis is given to the understanding of underlying processes rather than to monitoring. Applying these principals to specific, replicated laboratory, glasshouse, and field problems dealing with reclamation are encouraged. These reports are grouped into the following ASMR defined groups: ecology, forestry and wildlife, geotechnical engineering, land use planning and design, international tailings reclamation, soils and overburden, and water management.

Case Studies: Papers in this category report on reclamation activities over spatial or temporal scales. Monitoring of the response of ecosystem components (water, soil, and vegetation) to innovative practices are the basis for these case study reports.

Demonstration Studies: Papers in this category report on reclamation activities that do not necessarily include projects where significant amounts of data are collected. These may consist of largely photographic evidence of before and after some reclamation technique is applied. These may be observations that practicing reclamationists have observed that have changed how they continued to enhance the process of returning disturbed landscapes to a more desirable condition.

Policy or Review Papers: Submission of papers dealing with regulatory and procedural issues are welcome. These papers emphasize changing approaches to the science and technology of landscape revitalization. We strive to have them reviewed within 6 weeks.

Other: Letters to the Editor are accepted, and Book Reviews may be invited by the Editor-in Chief.

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ABSTRACTS OF PAPERS
CASE STUDIES

REDUCTION OF SPECIFIC CONDUCTIVITY IN COAL MINE EFFLUENT USING MEMBRANE TECHNOLOGY[1]

Zachary E. Kemak[2], Gregory D. Boardman, Jeffrey Parks, and Catherine Grey

Abstract. In recent years, researchers have reported a correlation between specific conductivity (SC) and total dissolved solids (TDS) and the health of aquatic organisms in receiving streams near coal mine valley-fill structures. Due to the potential for regulatory limits on SC and TDS, coal mining operations have begun to explore treatment technologies that could be used to reduce the levels of SC and TDS in receiving streams. Nanofiltration was evaluated based on its ability to reduce SC and meet a proposed limit of 500 µS/cm for mine water samples with moderate and high levels of SC from southwestern VA. Three nanofilters (NF270, DK, NFX) were tested without any pretreatment in the first phase of this project. The DK and NFX nanofilters were able to meet this SC limit for both mine waters tested with an average reduction of 84 percent for both mine waters tested. The NF270 nanofilters tested provided for an average SC reduction of 69 and 59 percent for the moderate and high SC mine waters tested, respectively. Performance in terms of SC reduction declined as ion concentrations increased in the influent tested. In the second phase of this project, microfiltration and simulated-sand filtration were introduced as a pretreatment stage in order to determine if SC reduction could be enhanced. Neither of the pretreatment options improved the SC reductions accomplished by nanofiltration.

Additional Key Words: microfiltration; nanofiltration; specific conductance; sulfate; total dissolved solids; ultrafiltration; valley-fill.

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[1] This paper was submitted for consideration in JASMR as a Case Study and was not presented at one of the ASMR annual conferences.

[2] Zachary E. Kemak is a master's degree recipient, Gregory D. Boardman is a Professor Emeritus, Jeffrey Parks is a Research Scientist, and Catherine Grey is a master's degree recipient, Civil and Environmental Engineering Department, Virginia Tech, Blacksburg, VA 24061.

http://www.asmr.us/Publications/Journal/Vol 7 Issue 3/Kemak-VA.pdf

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A PERMEABLE REACTIVE BARRIER (PRB) FOR THE REMOVAL AND IMMOBILZATION OF SELENIUM IN SEEP WATER AND SHALLOW GROUNDWATER AT A PHOSPHATE MINE IN SOUTHERN IDAHO: RESULTS OF BENCH SCALE TESTING[1]

William J Walker[2], David Tooke, Matthew Wright, Jeffrey Hamilton[2], Cindy Schreier,[3] and Jonathon Peterson

Abstract: A bench study was designed to determine the efficacy of a permeable reactive barrier (PRB) for removing elevated Se in groundwater and seep water at the toe of overburden storage area at a phosphate mine in Idaho. The bench testing was considered a first step in the pre-design considerations for developing an engineering and geochemical strategy for long-term water treatment options at the site.

The study consisted of three main parts: (1) characterization work designed to determine the basic chemistry of the site-water under consideration for treatment and the components of the proposed PRB. This data is a requirement for establishing the initial chemical conditions for assessing the efficacy of the PRB and its components. (2) batch leaching studies designed to assess the chemistry changes that each media component is expected to contribute to the overall water chemistry of the seep or groundwater in contact with the media. This batch study also allows a determination, prior to more extensive column testing, of whether unwanted chemicals or chemical changes will occur due to contract with the PRB media. (3) column studies consisting of vertical, 2-inch columns filled with the PRB media. Seep water and groundwater were delivered to the columns in an up-flow manner under a specified flow rate to allow sufficient HRT (12 and 24 hr) for Se reduction to occur.

The results of the studies indicated that the media proposed as components of the PRB posed no chemical changes of concern and resulted in rapid development of reducing conditions sufficient for Se reduction and immobilization. Column testing results were also very positive. The Se concentrations in seep water were initially about 10 mg/L and were reduced to about 0.2 mg/L after 25 pore volumes (PV) and 0.1mg/L after 50 PV. Increasing the hydraulic residence time (HRT) to 24 hr (a factor of 2) decreased the Se to just above the 0.05 mg/L water quality goal. The groundwater Se, initially about 1 mg/L was reduced to less than 0.02 in the first 3 hours of column contact time, well below the 0.05 mg/L water quality goal.

Overall, the results indicated that the PRB composition used in the study will be an effective means of meeting water quality goals at the site. The study provided much needed information on water and media composition information and the residence times required to accomplish Se reduction. Aside from Se reduction, no significant deleterious changes to water quality were observed when compared to primary water quality standards.

Additional Key Words: column and batch leaching, selenium reduction, selenium speciation, seep water, overburden, microbial reduction.

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[1] This paper was submitted for consideration in JASMR as a Case Study and was not presented at one of the ASMR annual conferences.

[2] William J Walker, PhD. Senior Geochemist; David Tooke, PhD. Associate Geochemist. Matthew Wright, PE Senior Engineer, and Jonathon Peterson, Project Geochemist, NewFields Companies, Mining and Energy Services, Missoula, MT. Jeffrey Hamilton. Senior Environmental Engineering Manager. J.R. Simplot Corporation, Pocatello, ID. [3] Cindy G. Schreier, PhD Chief Scientist, Prima Environmental, Sacramento CA.

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EUCALYPT PLANTATIONS FOR MULTIPLE PURPOSES IN THE HUNTER VALLEY, AUSTRALIA[1]

Ashley A. Webb[2], Georgina L. Kelly, and Nicholas L. Cameron

Abstract. Coal mining is central to economic development in the Hunter Valley, New South Wales, Australia with >100 million tonnes of black coal produced annually. Rehabilitation is mandatory following the mining process and ~20,000 ha of land is undergoing rehabilitation in the Upper Hunter Valley (UHV). The mean annual rainfall of <700 mm is significantly lower than typical for growing hardwood plantations. The traditional post-mining land use has been extensive grazing of beef cattle; however, in line with local government strategy replicated plantation forest trials were established in the late 1990s and early 2000s on buffer sites and reshaped overburden in the UHV to investigate the potential commercial viability of growing plantation forests as an alternative post-mining industry – for wood products and carbon credits. Following on from earlier establishment trials, the focus of this paper is the performance of the ~15 years old dryland plantations, with the objective of quantifying the benefits of an early non-commercial thinning and pruning regime. Seven hardwood eucalypts were trialed in this project: *Corymbia maculata* (Spotted gum), *Eucalyptus camaldulensis*, *E. argophloia*, *E. molluccana*, *E. sideroxylon*, *E. camaldulensis* x *grandis* and *E. camaldulensis* x *globulus*. The best all round performer to date has been Spotted gum. While it has grown well on buffer sites, most stands have performed as well or better on the reshaped overburden. Thinning at age 10-12 years has not led to an increase in overall stand volume; however, at the majority of sites it has increased the mean diameter and height of retained trees. Initial assessments indicate that thinning is likely to produce stands of better form resulting in the growth of higher value timber products. We developed an economic model to compare returns from grazing with expected returns from Spotted gum forestry and agroforestry using growth and yield projections. Net present values and internal rates of return indicate that forestry and agroforestry deliver comparable commercial returns (from carbon and wood products) to grazing but with a different investment and risk profile.

Additional Key Words: Mine site rehabilitation, Spotted gum, forestry, agroforestry, grazing, carbon sequestration, wood products.

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[1] Oral paper presented at the 2018 National Meeting of the American Society of Mining and Reclamation, St. Louis, MO: The Gateway to Land Reclamation, June 3 - 7, 2018. Published by ASMR; 1305 Weathervane Dr., Champaign, IL 61821.

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Mr. Nick Cameron is a professional forester with 28 years of management experience in Australian forestry. Nick is based in Sydney, New South Wales (NSW) working for the Department of Primary Industries' Forest Science unit as a forest resource analyst. Nick has extensive experience in plantation economics and environmental services including carbon sequestration and salinity mitigation.
Nick also runs his own forestry consulting business Forest Landscape Services and has a beef cattle farm in the Hunter Valley. Nick's formal qualifications include a Bachelor of Science (Forestry) degree from the Australian National University and an Executive Master's Degree in Public Administration from the University of Sydney. Nick was recently appointed a Fellow of the Institute of Foresters of Australia and is a current member of the NSW Forest Industries Taskforce.

Ms. Catherine Grey is a civil engineer with NAVFAC Atlantic. She received her M.S. in environmental engineering (2017) and B.S. in civil engineering (2015) from Virginia Tech, where she focused on drinking water, municipal and industrial wastewater treatment. Current areas of interest include emerging contaminants, such as per- and polyfluoroalkyl substances.

Mr. Jeffrey Hamilton, is a Senior Environmental Engineering Manager at J.R. Simplot Company and manages the historical mine CERCLA projects. He has a B.S. degree in Geology from Fresno State University and has been working in the environmental remediation field for 30 years. His emphasis has been on implementing efficient remedial options by integrating engineering practices with the site-specific geology and hydrogeology.

Dr Georgina Kelly is Executive Director, Science in the NSW Office of Environment and Heritage.***georgina.kelly@environment.nsw.gov.au***

Dr Kelly has been working in environmental programs for management, regulation and policy the last three decades. She has demonstrated expertise in natural resource research with a solid body of knowledge and practice built through her leadership of large, regionally dispersed divisions and programs to achieve evidence-based decisions in natural resources, climate, agriculture, forestry and mining. Dr Kelly has been appointed to more than 30 national committees and senior representative roles, is acknowledged for and has broad experience in environmental management, legislation, regulation and policy.

Dr Kelly's research includes the role of soils and forestry in climate mitigation and adaptation options; the potential of dry land forestry for carbon sequestration; and the successful use of recycled organics as fertilizers and soil amendments for mine site rehabilitation. Her research has focused on practical, large-scale industry situations. Dr Kelly's extensive research and demonstration program has been funded by all levels of Government and the forestry, coal, water and waste industries.

Mr. Zachary Kemak is a civil engineer with Black & Veatch. He received his MS in environmental engineering from Virginia Tech (2016) and BS in civil engineering from NC State University (2014). Current work focuses include water treatment, wastewater treatment, and sustainable infrastructure.

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Mr. Jonathan Peterson, L.G., is a project geochemist with NewFields Mining and Energy Services with an M.S. in Geology from Western Washington University and over 10 years as a field technician, coordinator, and scientific specialist for source investigations. Since 2015, he has published a surface water investigation in the *Journal of The American Society of Mining and Reclamation*, installed and fabricated parts for in-stream alert and data logging systems, repaired passive remediation systems, evaluated leach-tests of potentially acid generating materials, and investigated the origins of mining-site seeps using isotopic and ionic chemistry.

Dr. Cindy G. Schreier, is President and Chief Scientist at PRIMA Environmental, Inc., a company she founded in 1998 to provide an independent treatability testing, technology evaluations, custom laboratory work to the environmental community. Dr. Schreier has designed, conducted, and evaluated treatability studies to evaluate the effectiveness of a wide range of remediation technologies and assess their effect on secondary water quality parameters.

Dr. David Tooke, is a geochemist at NewFields Mining and Energy Services. He has a PhD in geochemistry and a masters in analytical/environmental chemistry from the University of Montana. He has been working in agricultural and mining industries for 16 years conducting remedial investigations, geochemical characterization studies, environmental data management, and fate and transport investigations.

William J Walker, PhD is a Senior Geochemist in NewFields Mining and Energy Services group in Seattle WA. He specializes in aqueous geochemistry and mine water treatment. His research focuses on application of nanotechnology to mine water treatment and development of passive modes of contaminant removal in surface water and groundwater. He completed his PhD at the University of California-Davis and has been a consultant to the mining industry for 30 years. He is also the director of the NewFields Geochemistry Laboratory in Seattle WA.

Mr. Matthew Wright, PE is a senior engineer at NewFields Mining and Energy Services. He has B.S. and M.S. degrees in Civil Engineering from the University of Wyoming. He has more than 20 years of diverse engineering experience in site investigation and remediation, mine water management, and water treatment.

Dr Ashley Webb has >20 years of research experience with honours degrees in Science (University of New South Wales) and Law (University of New England) and a PhD in Science (The University of Sydney). He has published 60 refereed papers in diverse fields including forest hydrology, water policy, soils and land and water management. He was previously employed by the Forestry Corporation of NSW for 12 years, firstly as a soil and water specialist then as Water Monitoring Manager. For the 5 years to mid-2018 Ashley was a leader and manager of R&D teams with the New South Wales Department of Primary Industries delivering applied projects and programs in partnership with industry R&D corporations. He has contributed to State and National committees on water quality, water information standards, plantation water use, and primary industries research, development and extension. Ashley is currently Manager Water Monitoring at WaterNSW with responsibility for the operation and maintenance of the organization's integrated surface water, groundwater and water quality monitoring networks. Ashley is based in Tamworth and leads a team of ~100 staff located throughout NSW, Australia.